ANEURISMS TREATED BY THE INTRODUCTION OF CATGUT, OR OF WIRE, WITH ELECTRICITY.[1]

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THE domain of cases upon which the surgeon may operate, owing to newly adopted principles, is enlarging year by year, and just in that proportion the number of "hopeless" cases diminishes. The most superficial observer will see a growing disposition to interfere with many varieties of infirmities for which in the past active treatment has been discouraged by all surgical authorities. One is led from time to time to review such maladies, and to ask whether advanced methods will yet allow us to touch them. As the miner has often found a fortune in the discarded ores of silver mines when worked over by a new process, so now some of the forbidden cases of twenty years ago are fairly met by justifiable new procedures.

In this spirit of inquiry I venture to open the question of the value of inferference with a small class of aneurisms, the treatment of which has heretofore been considered useless. This class is that of aneurisms springing from the aorta or its greater branches, and not amenable to the ligature or relieved by medicine, diet or rest. These are so common that we all see them from time to time. They run a steady downward course, interrupted, happily, in some cases by a temporary clotting, but soon advancing again, leaping the barriers of bone and cartilage until the thinned walls give fatal pressure-effects on veins, nerves, or the trachea, or sudden rupture ends the patient's misery.

Taking for our guide nature's attempt at repair by the two methods of deposition of firm clot, or by thickening the sac through hypertrophic, or inflammatory changes, we find the most promising to be that of inducing clot within the sac.

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Practically, accumulated experience shows that coagulation *will* take place upon certain foreign substances introduced into the current. Wire is especially favorable, either silver, iron or steel. This can be sterilized by preliminary boiling in carbolic solution. Thirteen cases of the use of wire have now been reported, to which I am able to add two more. The first attempt was made by Mr. C. H. Moore, of Middlesex Hospital, in 1864, of which I will speak later. Moore's method consists merely in the introduction of wire. Of the cases now on record, the most brilliant results were obtained last year by Loreta, of Bologna, and Morse, of San Francisco. The outcome of the others has not been curative, though seeming to look in the right direction.

Last year Mr. Richard Barwell practiced a modification of Moore's method, by introducing ten feet of steel wire into an aneurismal sac and passing a current of electricity through it, strong enough to obtain an electrolytic action and to induce the formation of a coagulum by quick deposit. Thus, he substituted a long wire, coiled in the blood current, for the short needle-point of so-called electro-puncture, which latter alone has in many hands been of unquestionable service in ameliorating the condition of aneurisms in the last stage.

Mr. Barwell's patient was a man with large aneurisms of the aortic arch, apparently a hopeless case, and associated with serious lung trouble. A fine, insulated trocar served to allow the steel wire to pass. The positive pole was attached to this while a negative pole of spongiopiline was spread over the back. A current of ten milliampères was passed for an hour and ten minutes. The man had no pain or inconvenience. The tumor gave no sign of immediate improvement, but in twelve hours "the man appeared much better, the tumor was more solid, and the pulsation more distant." Four days later a tumor appeared at the other side of the neck, which had been observed two years before, and then disappeared—evidently an extension of the sac in that direction. One week later he died of his pulmonary trouble. A post-mortem was obtained, and of the clot that was found in the aneurism he says: "The wide coils of wire are surrounded by thick, firm, colorless clot, which in many places binds the wire to the sac-walls, thus strengthening them and rendering rupture hardly possible where the wire had penetrated. In the secondary sac this had not formed." Barwell commends the method for large internal aneurisms.

Soon after the publication of Barwell's case, Dr. J. West Roosevelt, of this city, had an opportunity to try the method on a case of aggravated aortic aneurism threatening death. He has kindly offered me the case to report in this connection.

The patient was a man, æt. 25 years, with a syphilitic history. In November, 1885, he began to notice a dry cough; some weeks later dyspnœa and dysphagia ensued, and pain was present in the right pectoral region and axilla, occasionally extending down to the right arm, or into the back near the scapula. At that time also he noticed a pulsating tumor in front of the chest at the right of the sternum. His dyspnœa was great when he lay on the left side or back. He had been prevented from working for four months, yet he was in fair flesh. The pulsating tumor involved the four upper ribs near the sternum and gave a double bruit. He was given iodide of potash, was kept at rest, and somewhat under the influence of anodynes for two weeks with slight ease from pain, but the tumor continued to enlarge.

On August 4th, Dr. Roosevelt placed the man on his back, and inserted a short, insulated aspirator-needle into the tumor; when the blood trickled out he passed about seventy-five yards of fine steel piano-wire (No. 00). The patient experienced some feeling of weakness, became pale, and had pain, from the position on the back, to which he was unaccustomed. The wire was connected with one pole of a constant battery, and a large wet reophore was placed under the right shoulder. From four to eight cells of an ordinary galvanic battery were used, measuring 25 milliampères. It gave him no pain, and was continued for a half hour. The tumor still pulsated. He was kept quiet another half hour and then was put to bed. He had no pain subsequently from the operation. On the following night he required morphia for insomnia.

Next day the tumor did not pulsate so strongly, and he had some pain and vertigo. On the third day the tumor was less painful, but still pulsated. His breathing was not so comfortable, and in the evening his temperature rose to 100°, but fell to normal in the morning, and remained so afterward. On the fourth day dyspnœa and slight cyanosis appeared. On the seventh day he was better than before the operation, and had less pain and dyspnœa. By the tenth day the tumor was much less painful, the pulsation visibly diminished, and he could breathe easily lying on his back or left side, which he formerly could not do. During the third week he could swallow and breathe with greater ease, and the tumor felt harder. At the beginning of the fourth week he began to vomit, and to complain of headache. His iodide of potassium was, therefore, stopped. On the twenty-second day a painful, dark-colored spot appeared on one toe, and the man appeared badly. On the twenty-third day he died. No autopsy could be obtained.

In October last I had an opportunity to repeat this operation in the following case: A man, æt. 46, free from specific history, was referred to me by Dr. Naughton for treatment of a large pulsating tumor at the root of the neck on the right side. It had been observed as a very small swelling above the clavicle, not more than a year before, and had steadily enlarged until now it filled the supra-clavicular space, extending backward to the scapula. The greater growth of late had been back of the middle plane of the neck. A loud bruit could be heard over its entire surface. Its pulsation lifted the shoulder at every beat. Neuralgic pain of the right shoulder and arm had been coming on for several weeks, and pressure on the brachial plexus caused paralysis of the deltoid and triceps muscles. The right arm and right half of the face remained dry, while the opposite side was covered with profuse perspiration. There was slight hoarseness. The right pupil was smaller than the left, and ptosis of this eye had developed. The axillary, brachial, and radial pulses were small. A diagnosis of dissecting aneurism of the subclavian was made.

After consultation (Drs. Sands, Weir, Peters, McBurney, Bangs, Lange and Bull) it was decided that the condition would not be checked even by ligature of the carotid, with shoulder amputation, and being left with a patient whose pain was only eased by frequent hypodermatics of morphine, while the growth of the aneurism could be seen to advance every day, I decided to resort to Barwell's method, to lengthen his life, and, perhaps, to lessen the pain. The oval cavity of the tumor was estimated to measure four by five inches.

After three weeks' observation, under iodide of potassium, I decided to use catgut before employing wire. I operated on November 19, no anæsthetic being given. With a No. 2 aspirator-needle, I pierced the front of the sac, and the blood spirted out to a distance of two or three inches. No. 1 catgut, taken fresh from juniper-oil, and drawn through a damp sublimated towel, was easily, though slowly, pushed into the sac. It was best fed by short grasps of the thumb forceps. One hundred feet of it were thus introduced, occupying an hour. The patient lost two or three ounces of blood only, and had no pain, or discomfort whatever. There was a slight rise of temperature (to 101° F.), on the following day, the pulse remaining unchanged. The tumor was a little warmer than before. On the second day the patient continued to feel well. The outer third of the sac had very decidedly hardened; the remainder pulsated as before. An ice-bag was ordered to be applied. The radial and brachial pulses could not be felt. The hand continued warm. On the third day his temperature rose to 102°, though he felt otherwise as well as he did before the operation. After that his temperature declined rapidly to normal. The tumor, however, grew decidedly backward and upward during the week, and lifted the scapula. On the eighth day the dissection seemed much more rapid, and the hoarseness amounted to aphonia.

On the ninth day Dr. Roosevelt very kindly assisted me, and I introduced through an insulated aspirator-needle one hundred and fifty feet of fine steel wire, sterilized by boiling in carbolic acid solution; a copper plate a foot square, covered with cotton, was placed over his back and was connected with the negative pole, and the positive was attached to the end of the wire. A current was measured by Dr. Roosevelt up to fifty milliampères, which was the limit of the register. This required but fifteen cells; the entire thirty-six cells of the galvano-faradic battery were subsequently applied. The patient experienced no pain or discomfort. His pulse which had been 110, rose only ten beats during the process. The current was continued for an hour—the latter part of the time reversed so as to bring the negative pole within. He was rather exhilarated than otherwise, and when removed to bed would not have known that any operation had been done.

The tumor still pulsated when we concluded. On the following day I could perceive an increased firmness in the walls, though the pulsation continued. Subsequently the patient felt rather better, and I had some hopes of the outcome, when, on the second evening, he suddenly had a rupture of the sac into the trachea and expired. It was impossible to obtain an autopsy.

Although it is to be regretted that these cases could not be followed to the post-mortem table, there are yet some points of value in each that may be added to the study of the subject. It will be seen that both were utterly hopeless cases, and, while we cannot assert that life was prolonged, it was not shortened by the operation. In my own case the man was approaching his end, and it was his only hope.

The question may be asked, whether the rupture of the sac into the trachea was hastened by the pressure of the wire inside. I judge not, for the tracheal pressure that preceded the rupture had been progressively getting worse, as evidenced by the hoarseness increasing for a month—showing that it was making its way toward the trachea. I find three other cases of rupture following active treatment. One of Churton's last year, in which he had used electro-puncture without wire, and in twenty minutes fatal hemorrhage from the trachea ensued; the other was Domville's case of aortic aneurism, in which he put fourteen inches of iron wire into a sac, and when four weeks later the man died of sudden rupture into the pleura, it was found that no wire was near the perforation. The same occurred in Dr. Ransohoff's case, reported at the last meeting of the American Medical Association; over ten feet of silver wire were introduced into the sac, in two sittings, three weeks apart. Death suddenly occurred one week after the last, from rupture into the pleura, but the autopsy showed that there was no wire near the place of rupture. (*The Medical News*, May 29, 1886, page 597.

Whether the duration of life was longer or shorter owing to the treatment by wire insertion, is pure speculation. My own impression is, from studying all the cases, that without exception everyone was in a desperate state before operation. Some even threatened dissolution. My own patients lived thirty-six hours only, before rupture occurred. Most of them lived several weeks, and Loreta's, ninety-two days, having apparently been restored to health, while Morse's still survives. In one case reported by Mr. W. Cayley, the large aneurism at the root of the neck became solid and the patient lived eighty-six days after some forty feet of steel wire were introduced. The thoracic portion of the aneurism extended, and Mr. Gould subsequently put in thirty-five feet more to solidify if possible the portion that was causing serious dyspnœa. No disturbance followed nor was he relieved.

As regards the chances of emboli from the wire giving trouble, I find but two of the fifteen cases in which wire was introduced, that caused such an accident. Mr. Moore's case, the first on record, showed at the post-mortem suppurating foci in the kidneys, with death on the fifth day. As the case occurred in 1864, it is quite as probable these were septic as that they were embolic. No case that has since been done has shown septic infection due to the care now exercised in sterilizing the wire.

In a note in the *British Medical Journal* of May, 1885, Dr. Maclean, who witnessed Mr. Moore's operation twenty-three years ago, and who saw the organs and aneurism after the autopsy, says that the immediate cause of death was inflammation of the sac and the pericardium, and also he recalls the innumerable clots in the fresh preparation, of varying consistence, hanging from the wires, ready to drop into the blood, and emboli exactly like them were found in the arteries of the organs dissected to show them." In Dr. Roosevelt's case a dark-colored, painful spot appeared on one toe on the twenty-sixth day. The absence of other reported accidents by emboli, shows that it is no more to be feared from wires than from the untreated walls of an aneurism.

Having shown that nature will tolerate considerable quantities of wire for periods of eighty-six and ninety-two days, and even indefinitely in favorable cases, as in Dr. Morse's. and that it has never been known to induce suppuration when aseptic, it is now of importance to see how much solidification is really brought about by the foreign substance. Of the sixteen cases of wire-insertion, eight were followed to an autopsy. Bacelli's third case, in which seven watch-springs, each about twenty inches long, were inserted, was the only one which failed to show coagulation. The patient lived only two days. His second case, in which three springs were introduced, lived ten days, and excellent clots were found around the metal. His first case, in which only one spring was used, lived two months, was improved, and presumably the wire was imbedded. In Domville's case fourteen inches of iron wire were found imbedded in firm clot, two weeks after its introduction into an aortic aneurism, the patient dying of ruptured sac. Dr. Ransohoff reported last year a case of large aneurism at the root of the neck, into which he put at two sittings ninety-eight and ninety-six inches of silver wire. The case was hopeless from the first; however, the patient survived over four weeks. Autopsy showed the "coils of wire imbedded in recent and old clot." In Mr. Cayley's case of large sacculated aneurism of the aortic arch, the patient survived the introduction of seventy-five feet of steel wire eighty-six days, and the "entire upper portion of the sac was filled with clot, in which the wire was imbedded." In Barwell's case (already quoted) the electricity and wire combined had caused the latter to become "surrounded by thick, firm, colorless clot, which in many places bound the wire to the sack-walls, thus strengthening them." In Prof. Loreta's famous case (reported last summer) the post-mortem revelations were very gratifying. The patient was a sailor, who had aneurism of the abdominal aorta, the size of a small fœtal head. Laparotomy showed it to be matted to the viscera, stomach, etc., from which it was separated. Six and a half feet of silvered copper-wire were introduced through a fine canula, the point of perforation was touched with pure carbolic acid, and the wound was closed. He made an excellent recovery. Twenty days later the pulsation had ceased, and by the seventieth day he resumed his work. On the ninety-second day the aorta ruptured at the point at which the sac sprang from it. Autopsy showed that the latter had shrunk to the size of a walnut, and was completely filled with coagula of organized fibrin. The wire was found unaltered, and rolled into a globular mass within the sac.

Dr. Morse's patient, in San Francisco, a man of thirty-two years, received a blow from a coal bucket which resulted in an aneurism of the abdominal aorta, which grew for eight months, accompanied with much suffering. Loreta's operation was done, and four and a half feet of silvered copper wire introduced into the sac through the laparotomy wound. The tumor was the size of two fists.

The patient's subsequent temperature remained below 101°.

On the ninth day the left femoral artery became plugged, whether from embolism or endarteritis cannot be said. Pulsation returned in it, however, in the fourth week. The tumor shrank to a small nodule, and so remained without bruit. The patient left the hospital less than eight weeks after the operation—apparently cured.

Dr. Lange reported a case to our society quite recently, in which he obtained an autopsy. He had inserted thirty feet of wire into an abdominal aneurism. The patient survived twelve days. The specimen showed the wire imbedded, to a large extent, in firm clots against the wall, but free in some places in the current. It is reasonable to believe that it would always be buried in laminated clot, if left for a while.

As bearing upon this point, I would note that Schrötter, of Vienna, two years ago inserted twenty inches of Florence-silk into a large aneurism, and four days afterward thirty inches more. The patient died in the third week, of pulmonary œdema, and the autopsy showed the silk in coils entirely enclosed in laminated clot. In Bryant's case of popliteal aneurism, the horse-hair was enveloped (to use his words) in "huge laminated clots." The inflammation of the sac-wall probably plays no small part in aiding solidification. I feel convinced that it is desirable to provoke some inflammation. In my patient there was a decided increase of local temperature in the outer part of the sac, with slight œdema of the subcutaneous tissue, and hardening of the sac. This followed on the second day, after one hundred feet of catgut had been introduced. The continuous application of an ice-bag entirely controlled the inflammatory action. In Schrötter's case of silk introduction it is reported that "intense œdema appeared in the vicinity of the sac from its inflammation," the virtue of which was apparent, in the imbedding of the silk, as was found three weeks later at autopsy.

Finally, I would review the part that electricity may play in the combined treatment. We have but three cases in which the sac was subjected to electrolytic action through an extensive wire coil within it. Barwell used a current of ten milliampères, Dr. Roosevelt about twenty-five, and I one hundred. The patients experienced no pain or discomfort whatever. The current was passed for a period of from half an hour to an hour and ten minutes. In my case the current was reversed during the latter half hour, so as to bring the negative pole within. No change in the patient's condition could be perceived, and no gas could be discovered in the sac, as in some cases of electro-puncture, where it became tympanitic for a short time, without harm.

The promising statements of Cinicelli and others about the value of electrolysis in aneurisms have seemed to many delusive. The small amount of coagulation that takes place around a fine needle, is perhaps of less value than the irritation of the sac. Therefore, it seems reasonable to my mind that if we tangle a mass of fine wire so that it will reach every part of the sac, and then cause a deposition of clot on it by electrolysis, we do more justice to the method. Cinicelli claims that no cure of aneurisms takes place afier electrolysis without inflammation of the sac.

Occasionally a case succeeds, as one reported by Dr. Simpson, of Manchester, in 1881; an aortic aneurism that had eroded the rib and threatened to rupture, continued well five years after repeated electro-puncture.

As regards the strength of the current to be applied, experience only will say. De Watteville thinks that twenty or thirty milliampères for each needle are sufficient, others five or ten. But, when a large wire surface transmits the current, it is probable that fifty or one hundred are not too strong.

CONCLUSIONS.—It is evident that we need many accurate scientific observations before we can speak definitely of the value of Barwell's method, One may say that Moore's treatment, by simply placing wire in the sac, has not yet been tried in any case that was not already hopeless and in the last days of life. The same may be said of Barwell's ; yet the evidence warrants a continuance of its trial. It is not a coincidence that cases show a decided amelioration of symptoms.

It has been proved that there is a deposition of clot; sometimes so abundant as to cure, as in the cases of Loreta and Morse. The fine wire is so yielding that it may be compressed by the aneurismal contraction into a small fraction of its bulk, without exerting much expansile reaction against the wall; and it is probable that an hour's electrolysis so far weakens it, as well as roughens its surface, that it is quite prepared for the deposition of the clot and the shrinkage of the sac.

The operation is not in itself perilous; no deaths have occurred from its performance. The subsequent much-desired inflammation of the sac was easily kept under control by ice-bags in every case.

The principle does not seem faulty, and its application should not be abandoned or condemned, until much more extended trial has been given to it.